

Eco-systems of agricultural landscapes
and sustainable land use: Livestock systems

05 - Livestock Environment Interaction - 1

Introduction



The current land use problem

Increasing population and consumption are placing unprecedented demands on agriculture and natural resources.

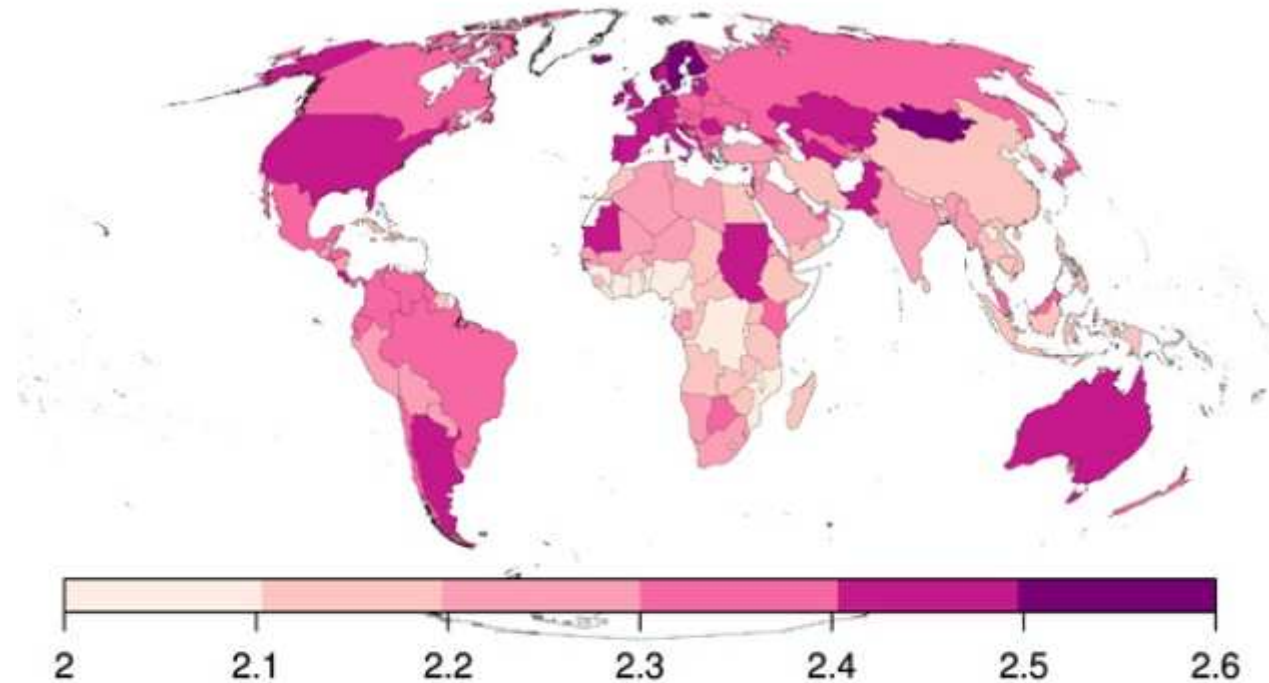
Today, approximately a billion people are chronically malnourished while our agricultural systems are concurrently degrading land, water, biodiversity and climate on a global scale.

To meet the world's future food security and sustainability needs, food production must grow substantially while, at the same time, agriculture's environmental footprint must shrink dramatically.



Nature News, 02 December 2013

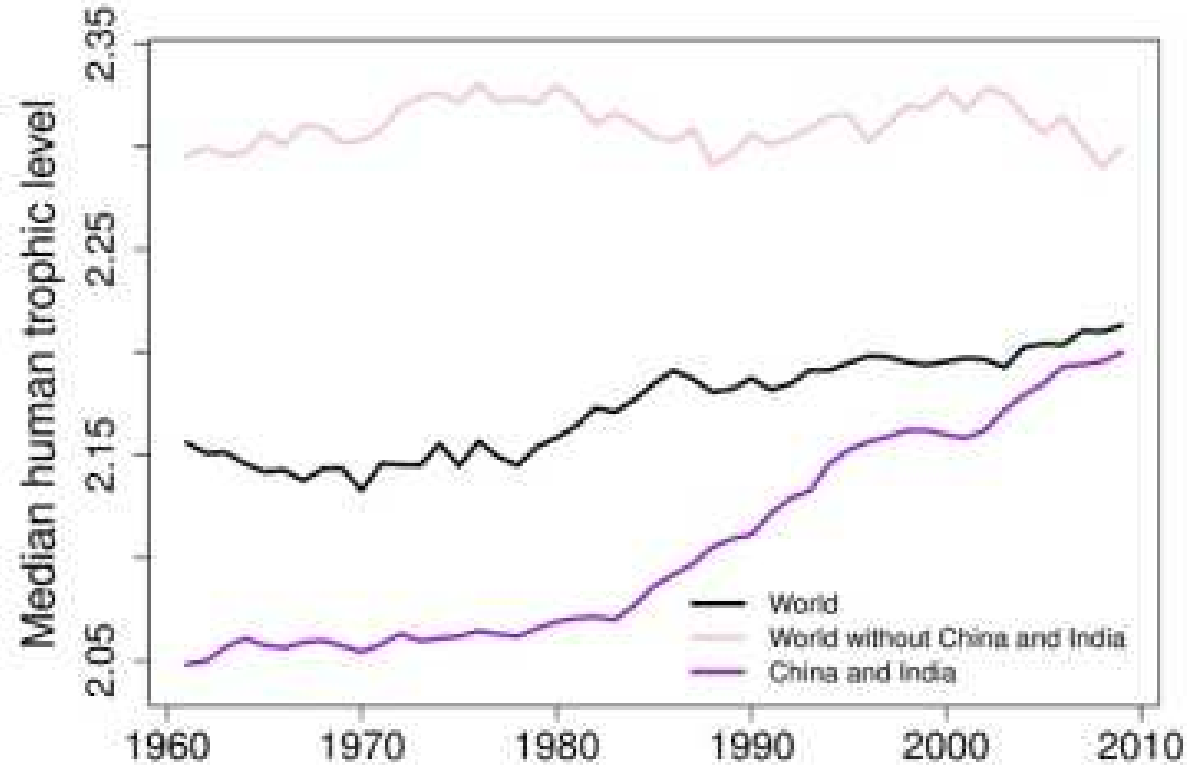
Humans are becoming more carnivorous



A country-by-country breakdown of the median human trophic level, which shows humans' place in the global food chain on a scale that goes from 1 (organisms such as plants that get their energy from the Sun) to 5.5 (top predators such as polar bears or orcas).



Globally, the human trophic level increased by 3% from 1961 to 2009, driven largely by more meat consumption in India and China



<http://www.nature.com/news/humans-are-becoming-more-carnivorous-1.14282>



Some solutions

Halting agricultural expansion

Closing yield gaps in “underperforming” lands

Increasing agricultural efficiency

Shifting diets

Reducing waste

Improving food global distribution



How to measure the wealth of Nations

GNP (Gross National Product)	This is the value of all goods and services produced by a country per year divided by the number of inhabitants [US\$]
Gini Coefficient	The Gini coefficient is a number between 0 and 1 which describes the distribution of wealth in a society
Life Expectancy	Number of years a newborn child is expected to live
HDI (Human Development Index)	It is calculated from GDP in relation to life expectancy and education level
Ecological Footprint	Represents the agricultural area [ha] needed to produce all resources needed (food, raw materials, energy) per inhabitant per year
HPI (Happy Planet Index)	Relates HDI with ecological footprint and the happiness expressed by inhabitants in surveys

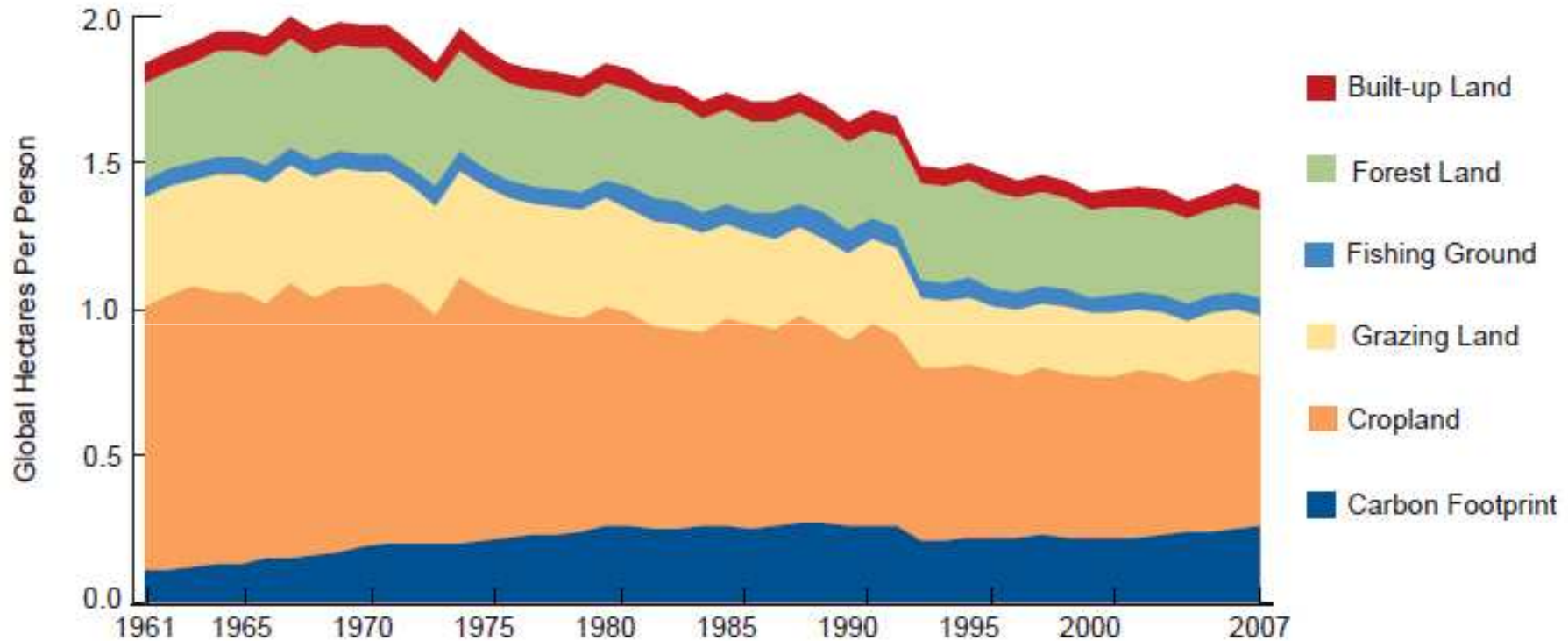


Breaking down the ecological footprint

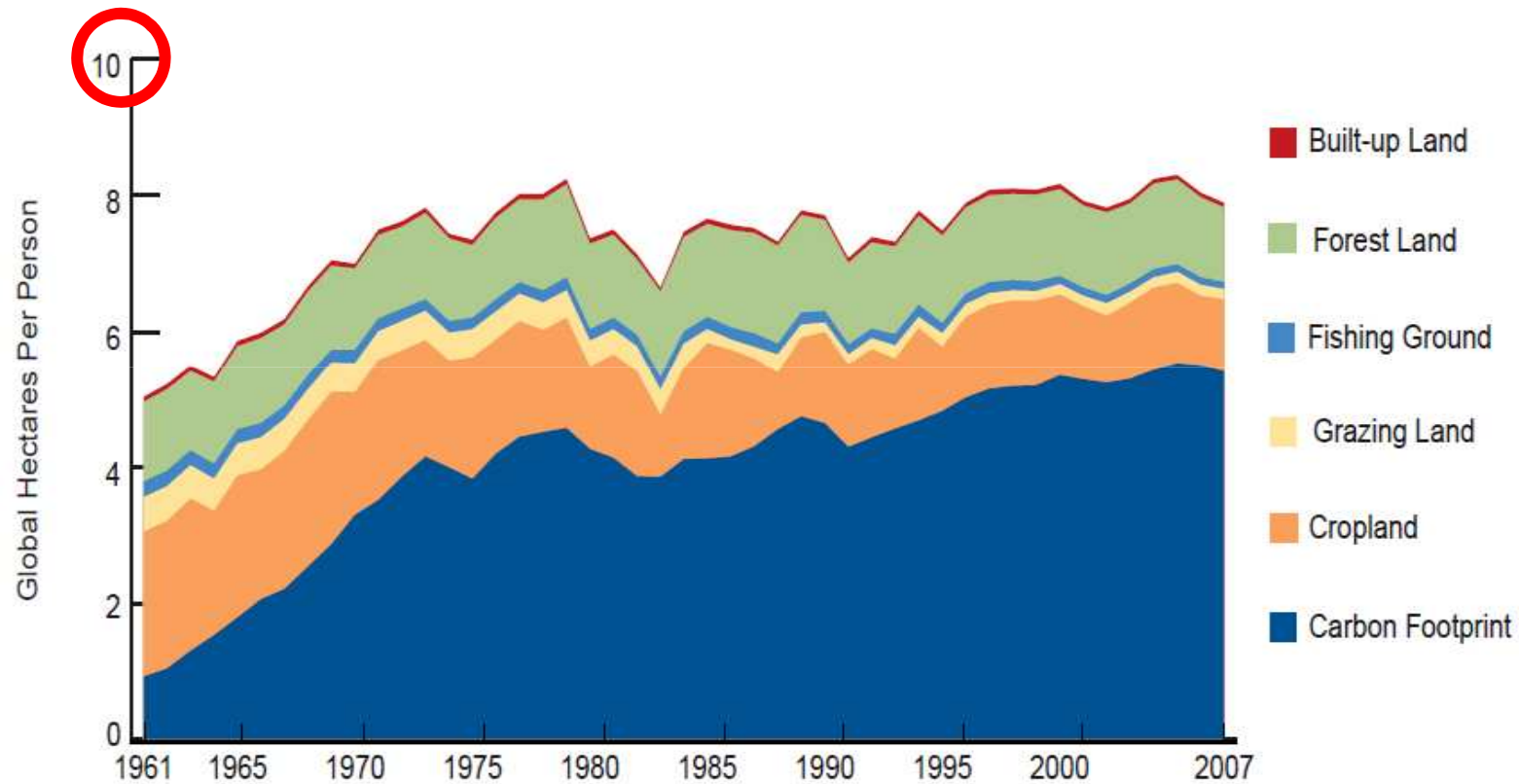
Ecological footprint	Global ha of productive land needed to produce all goods and services consumed by a nation, an individual, a business enterprise, a production sector etc.
Carbon footprint	Amount of carbon released into the atmosphere minus the amount of carbon sequestered through biological or technical processes resulting in goods and/or services
Water footprint	Amount of water consumed, degraded or devalued through biological or technical processes resulting in goods and/or services
Energy footprint	Amount of energy expended (degraded) in biological or technical processes resulting in goods and/or services



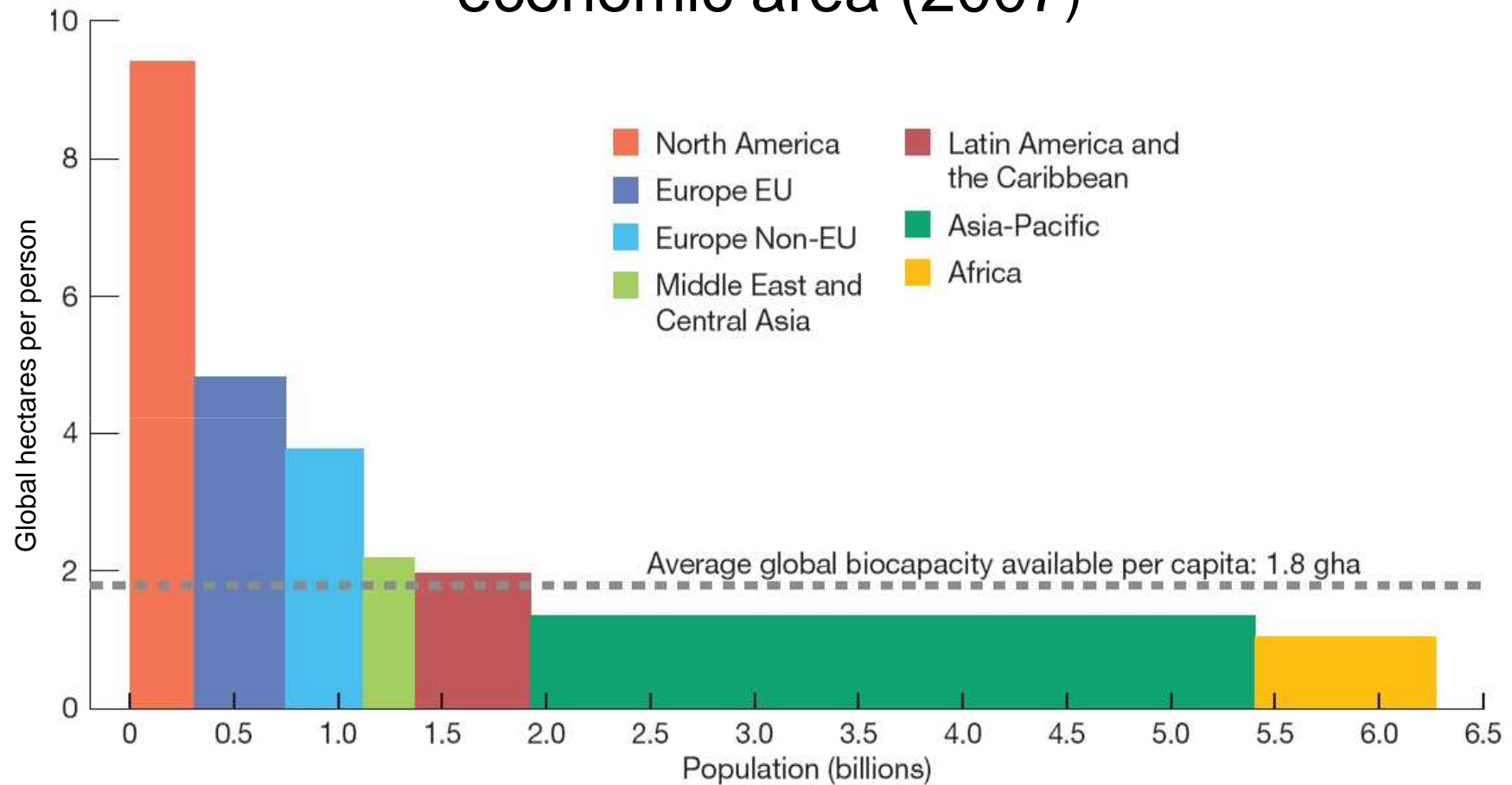
Ecological footprint [global ha/head/year] for different land use sectors in **Africa**



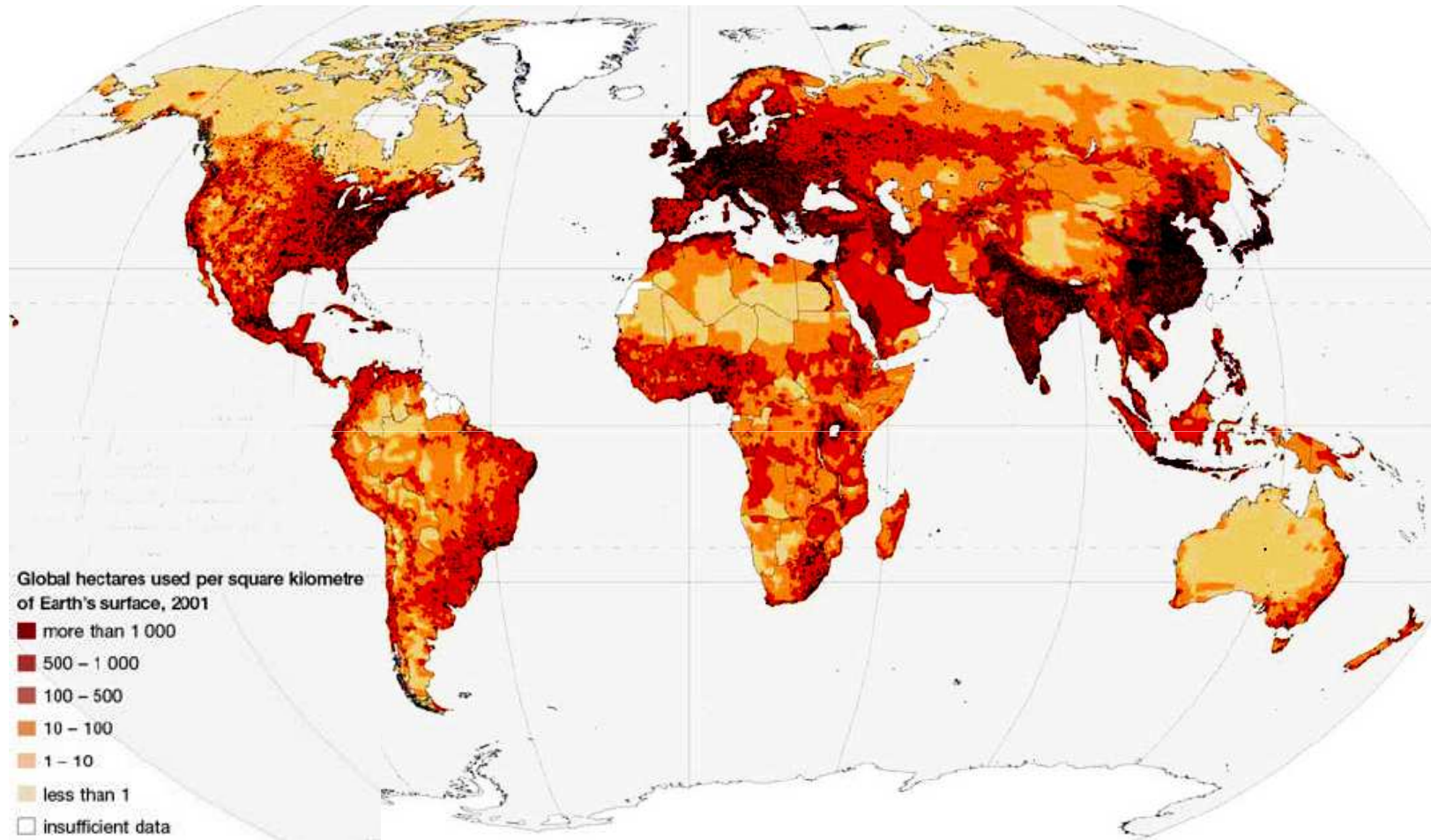
Ecological footprint [global ha/head/year] for different land use sectors in **North America**



Average ecological footprint by economic area (2007)



Global distribution of ecological footprint intensity



World Ecological Footprint and Bio-capacity, 2003

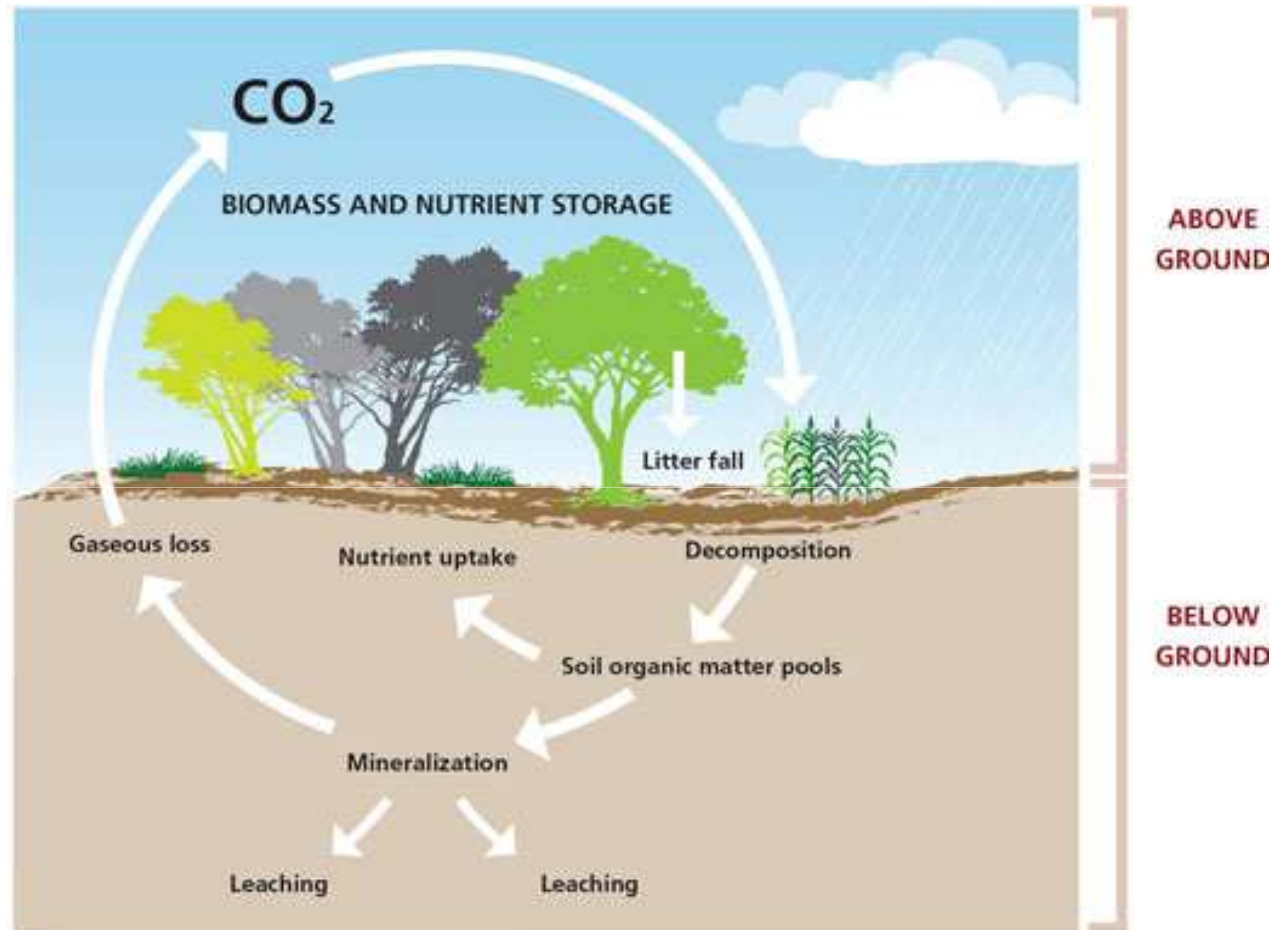
Both Ecological Footprint and bio-capacity are expressed here in global hectares.

Land Type	Ecological Footprint	Bio-capacity
Cropland	3 040 000	3 305 000
Pastures	914 000	1 683 000
Fishing Grounds	936 000	859 000
Forest	1 438 000	4 898 000
Carbon and Nuclear	7 263 000	
Built-up Area	483 000	483 000
Total	14 073 000	11 198 000

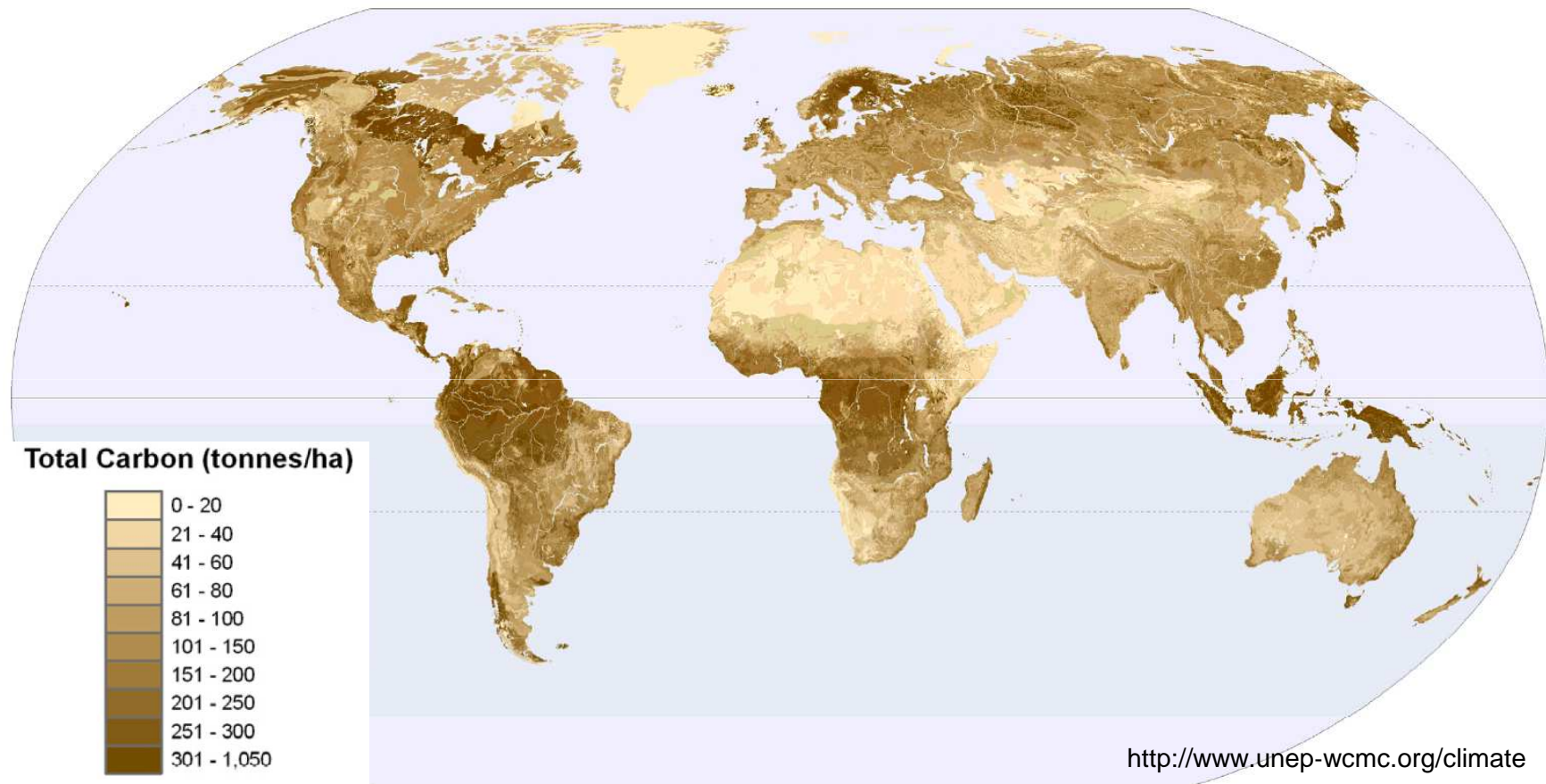
Source: Meadows et al. 2004. Land Use Policy, 21.



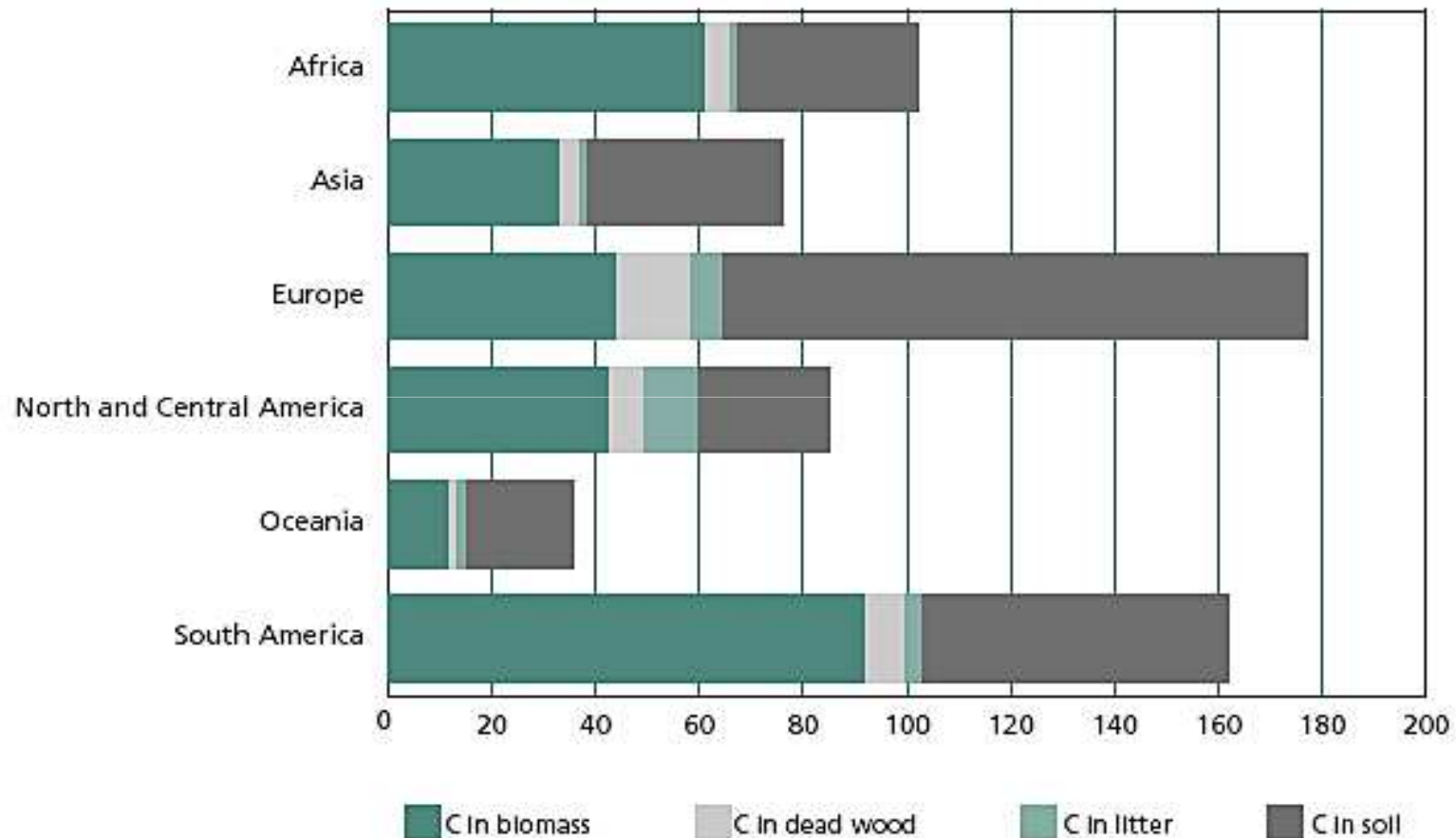
Simplified scheme of the terrestrial carbon cycle



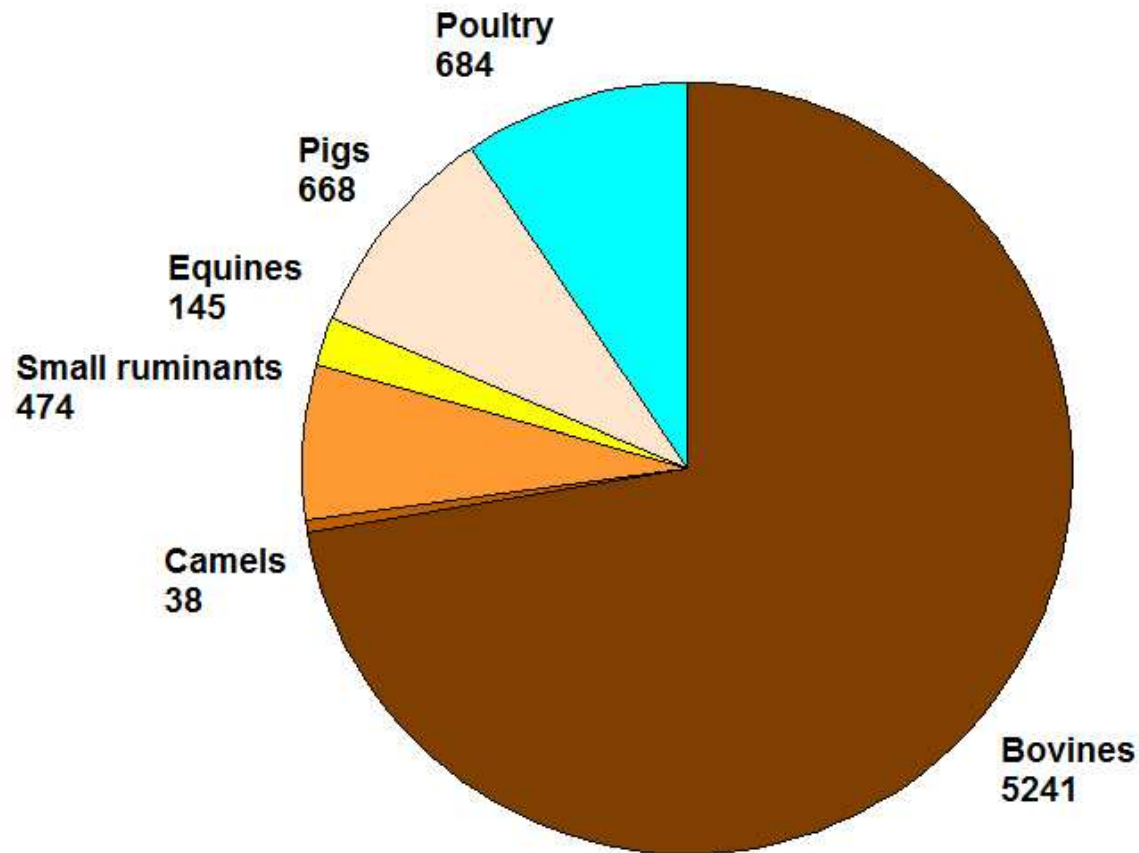
Global map of terrestrial carbon embedded in vegetation biomass



Global terrestrial carbon stocks [tonnes/ha] by continent

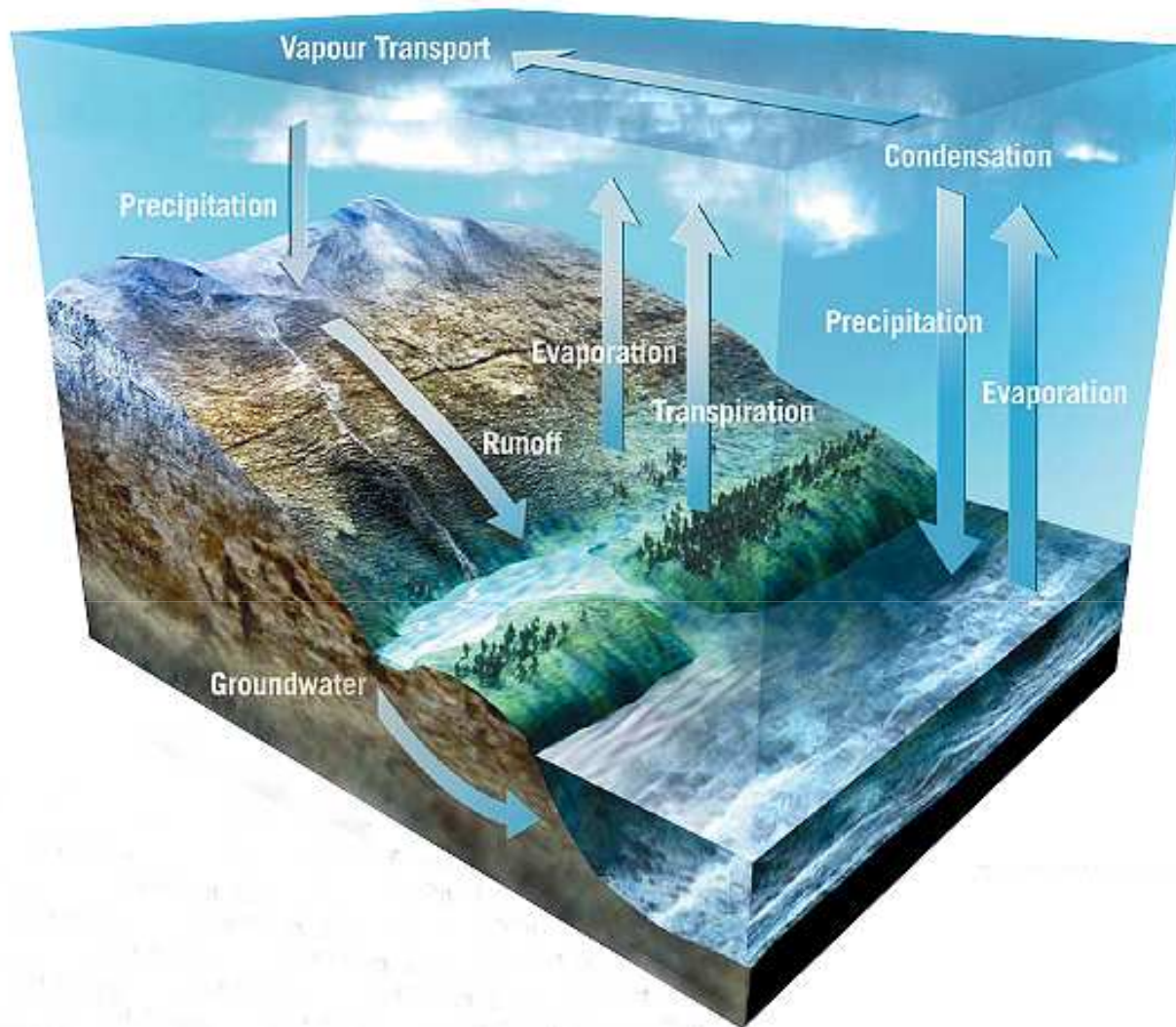


Global CO₂-eq emissions from livestock [million tonnes/year] by species



Source: GLEAM 2012





Global Water Cycle



Water typology

Blue water

Sweet surface water or water stored in accessible aquifers, transportable, multiple uses

Green water

Sweet water stored in unsaturated soils, immobile, usable only for growing vegetation

Grey water

Contaminated blue water which might be usable in appropriate systems or after treatment

Brown or black water

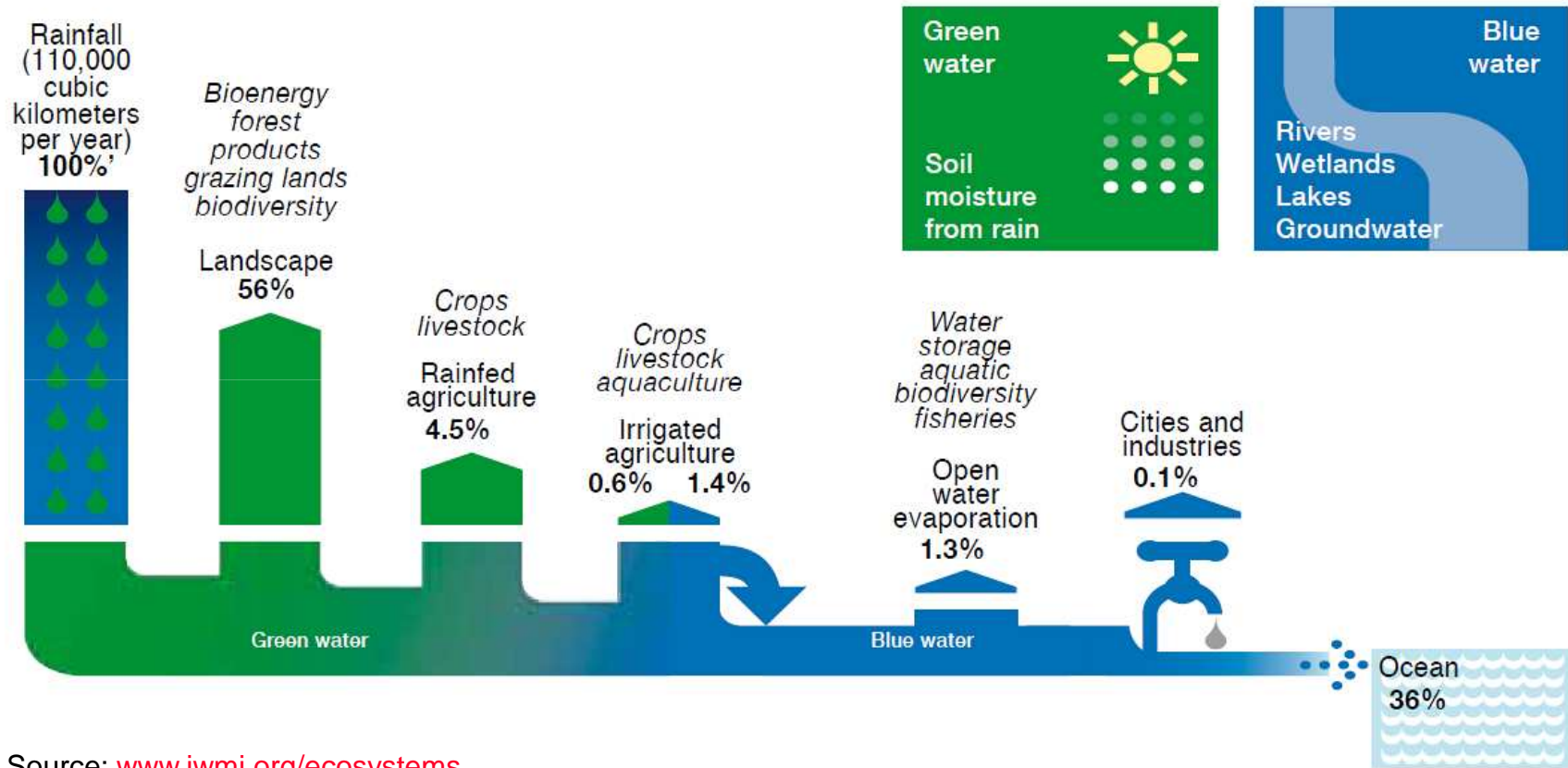
Heavily contaminated water, toxic, radioactive, which cannot be reused easily

Virtual (embedded) water

Sum of all water which is depleted, degraded and devalued in the process of producing goods and / or services



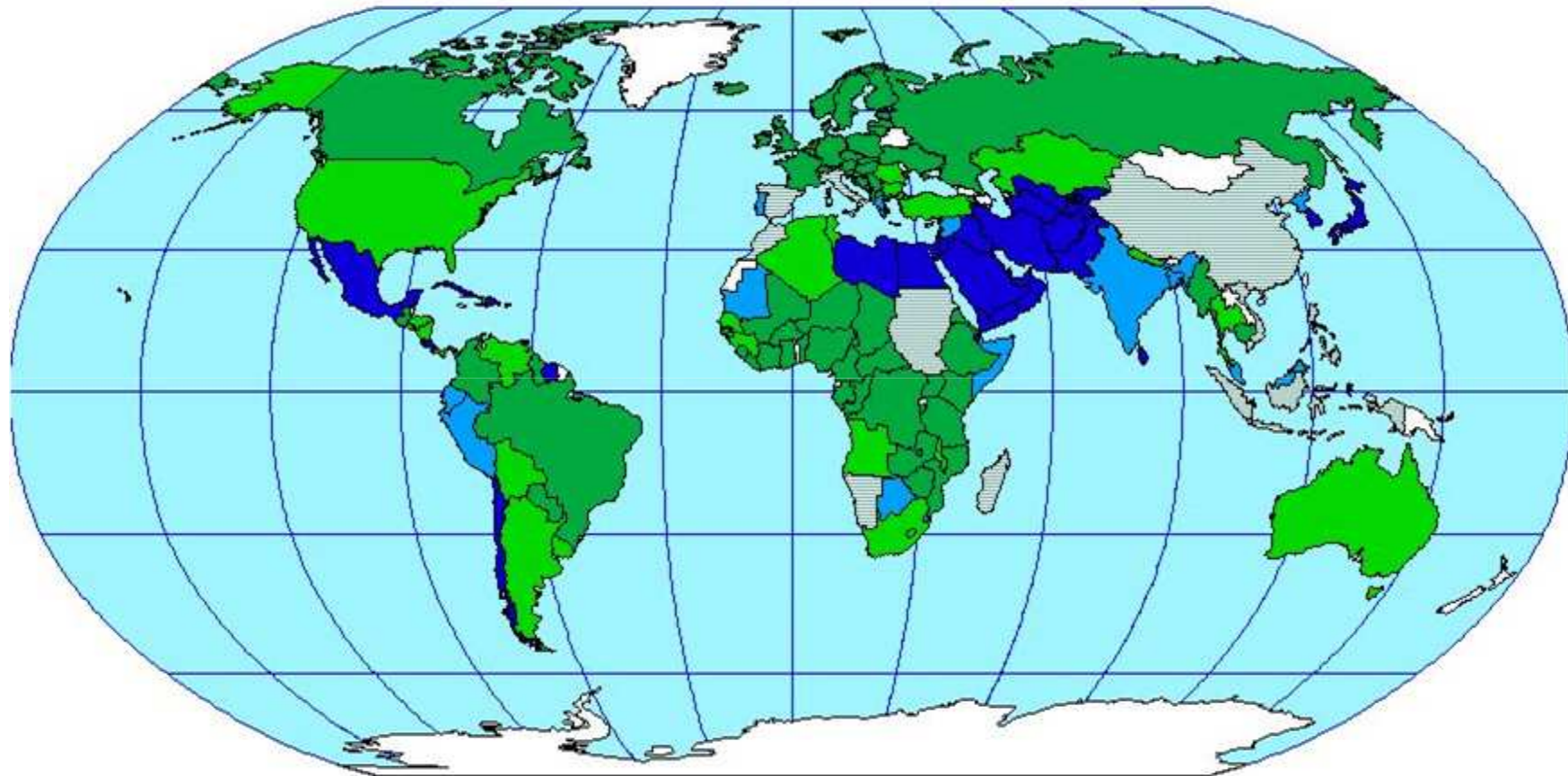
Overview of global water use by sector showing consumption of water stored in the soil profile (green water) and water stored in surface water bodies and aquifers (blue water)



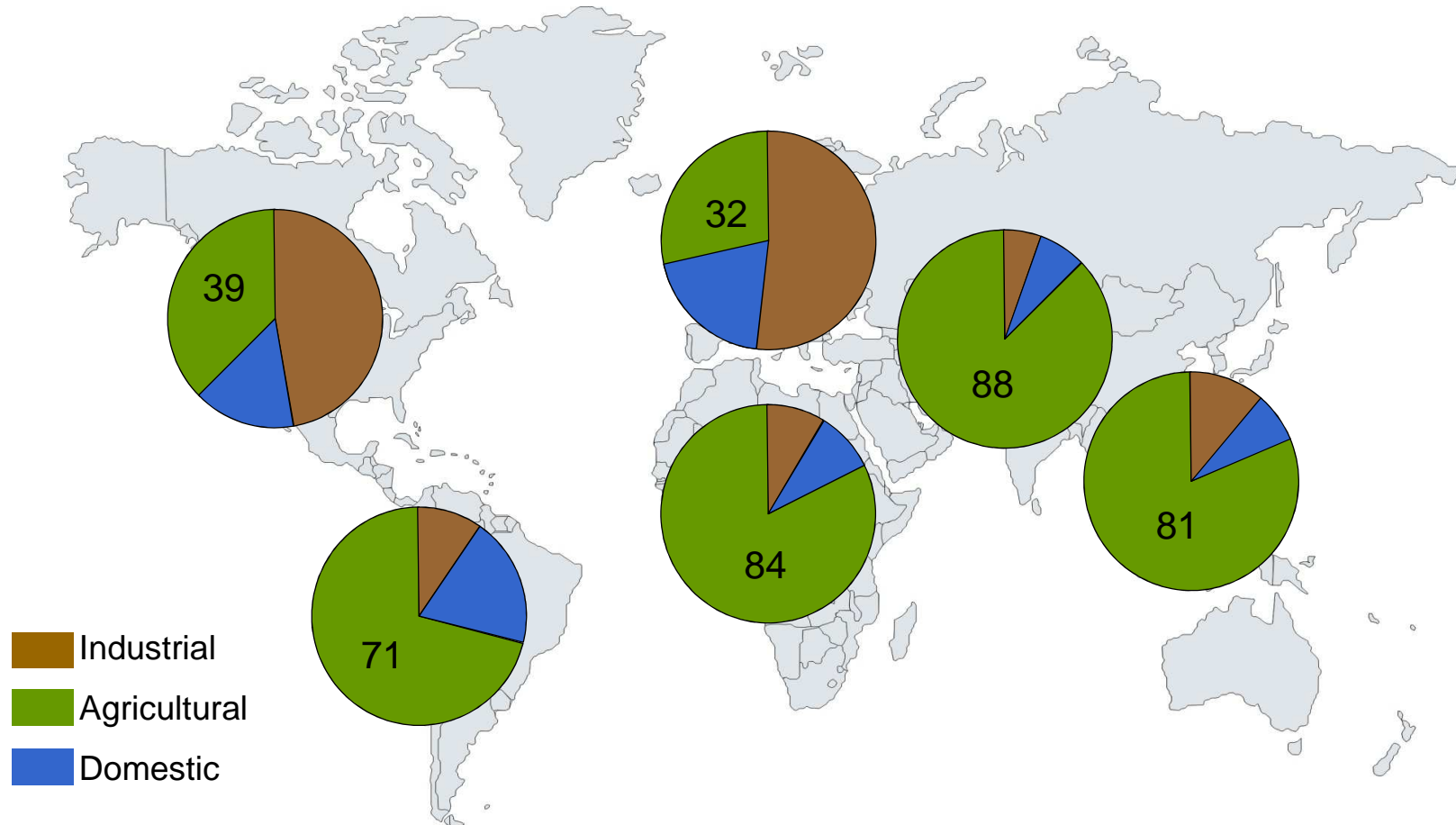
Source: www.iwmi.org/ecosystems



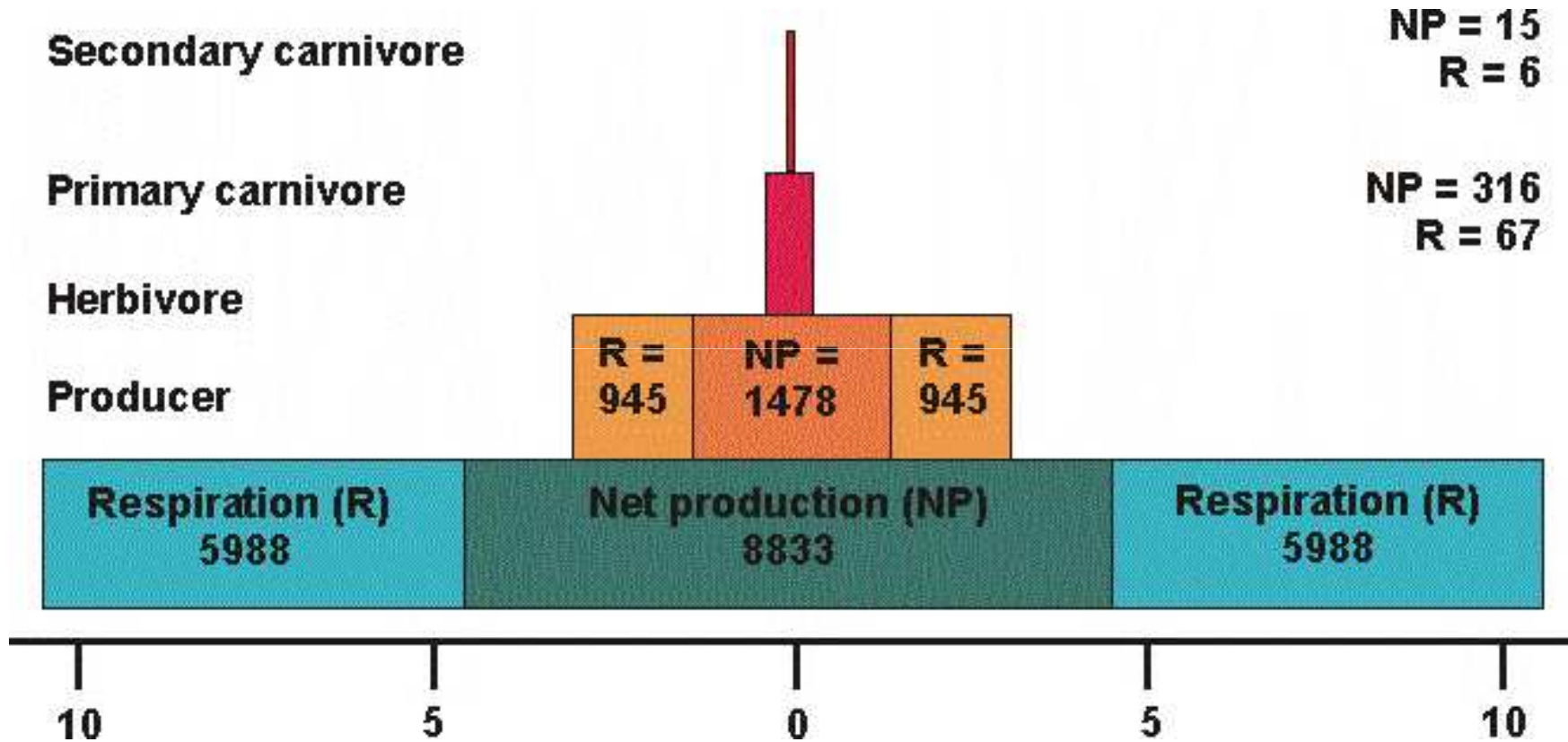
World map of GREEN and BLUE water dependence in food production



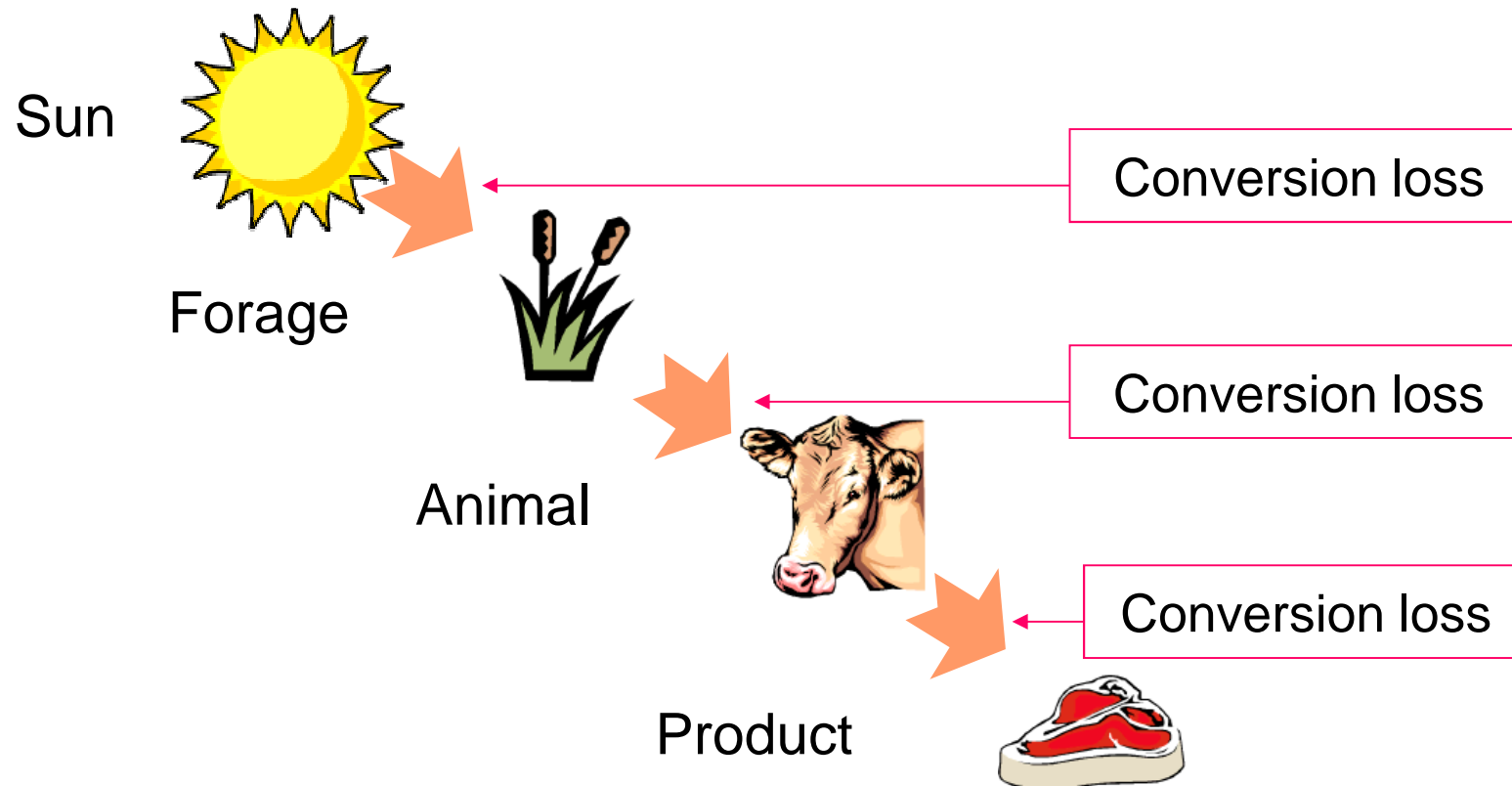
Breakdown of water use [%] by economic sector in industrial and developing countries



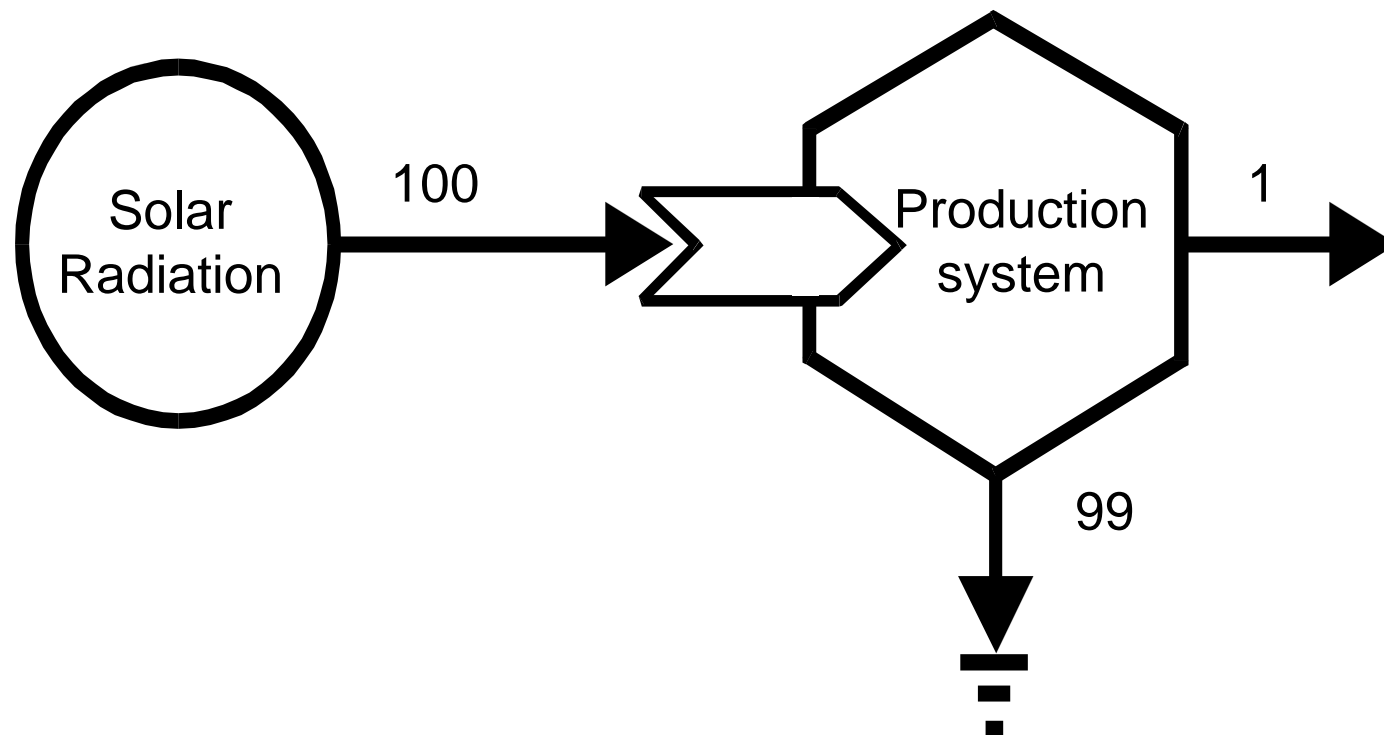
The concept of energy degradation at transformation between trophic levels within an eco-system



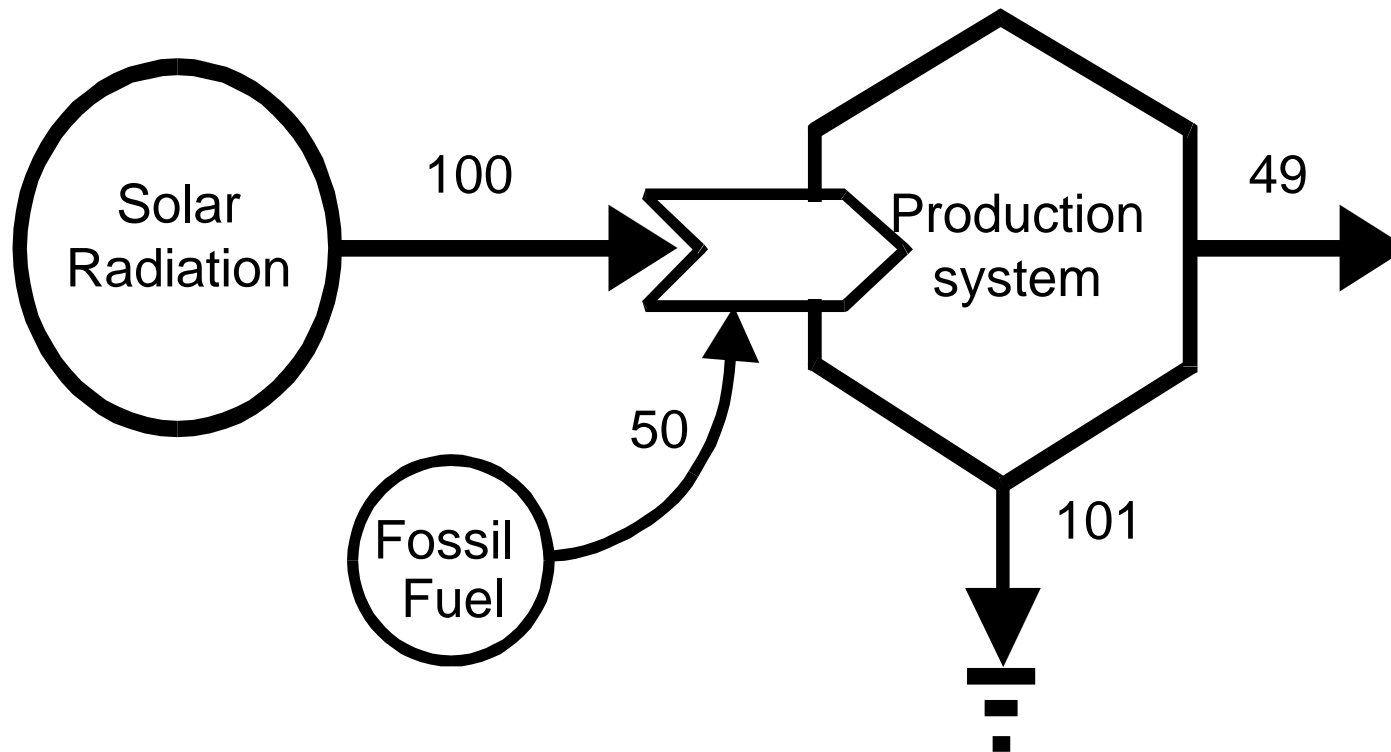
A model of energy flow in a livestock production system



Schematic presentation of energy conversion in a **near-natural** livestock production system



Schematic presentation of energy conversion in a livestock production system **with fossil fuel input**



What efficiency needs to be emphasised?



Productive
Biological



Economic



Ecological

